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Determinants of fatigue in children and adolescents with type 1 diabetes mellitus: A systematic review

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Abstract

Background: Fatigue is one of the most common non-specific symptoms experienced by children and adolescents with type 1 diabetes mellitus (T1DM), yet it often goes unnoticed by clinicians. It can affect quality of life, learning ability, and engagement in daily activities. Fatigue in T1DM patients is not only related to glycemic control, but is also influenced by a complex range of physical, psychological and social determinants. A comprehensive understanding of the factors that contribute to fatigue in this population is essential for the development of more effective and holistic intervention strategies.
Purpose: To determine fatigue among children and adolescents with Type 1 Diabetes Mellitus.
Method: A systematic review with article selection guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The article search was conducted systematically using the keywords: "Child" AND "Children" AND "Adolescent" AND "Adolescence" AND "Teenagers" AND "Diabetes Mellitus Type 1" AND "Type 1 Diabetes" AND "IDDM" AND "Type 1 Diabetes Mellitus" AND "Juvenile Onset Diabetes" AND "Psychosocial Problem" AND "Psychosocial Support System" AND "Psychological Support System" AND "Social Support System". This study is registered on PROSPERO (CRD42024618445).
Results: Aside from anxiety, depression, and behavioral disorders, other psychosocial issues—specifically self-management difficulties—are also observed in children with T1DM. These challenges are often associated with fatigue, which can negatively affect a child's motivation, focus, and ability to consistently carry out essential diabetes care tasks such as taking insulin, monitoring blood sugar levels, managing diet, and engaging in physical activity.
Conclusion: The findings related to fatigue as a psychosocial issue may offer evidence-based support for the early identification and intervention of psychosocial challenges in children and adolescents with T1DM.

Keywords: Adolescents; Children; Fatigue; Type 1 Diabetes Mellitus.

INTRODUCTON

Type 1 Diabetes Mellitus (T1DM) is a chronic condition that typically develops in children and adolescents. It is primarily caused by the immune system's destruction of pancreatic β-cells by T-cells, resulting in an autoimmune response where the body attacks its own cells. This damage progresses at different rates, and clinical symptoms of T1DM generally appear once about 90% of the β-cells are destroyed. At this point, the pancreas can no longer produce insulin, requiring lifelong external insulin injections to regulate blood sugar. Because T1DM requires continuous, long-term treatment from an early age, many children and adolescents experience fatigue, which can contribute to psychological,

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behavioral, and social challenges—particularly during adolescence (Romadlon, Hasan, Wiratama, & Chiu, 2022).

An article stated that the prevalence of fatigue associated with T1DM ranges between 23% and 40%. Fatigue is recognized as a psychological symptom that can interfere with both self-care and blood sugar regulation. The relationship between diabetes and fatigue is bidirectional: not only can diabetes cause fatigue, but fatigue can also worsen diabetes management. Psychosocial factors are crucial in managing T1DM. Elements such as emotional health, self-confidence, social support, and coping skills greatly influence a young person's ability to follow treatment plans, including insulin use, blood glucose monitoring, dietary management, and physical activity (Thorsteinsson, Loi, & Rayner, 2017). When children and adolescents have strong mental health, supportive families, and positive peer relationships, they are more likely to manage their diabetes consistently and effectively (Blair, McKay, Ridyard, Thornborough, Bedson, Peak, & Gamble, 2019).

However, psychological distress—such as anxiety, depression, or diabetes burnout—can significantly reduce motivation and the ability to adhere to medical recommendations, ultimately impacting glycemic control. Research has linked poor psychosocial functioning to higher HbA1c levels, more diabetes complications, and increased hospitalizations. As a result, comprehensive diabetes care should include not only medical treatment but also regular psychosocial evaluations and interventions (Katsarou, Gudbjornsdottir, Rawshani, Dabelea, Bonifacio, Anderson, & Lernamark, 2017).

Adolescents with T1DM face a higher risk of mental health issues compared to their non-diabetic peers. Studies indicate that rates of depression and anxiety in this group are nearly double. Research has also shown a connection between mental health issues and academic performance; for example, one cross-sectional study found that high depression scores in adolescents with T1DM were linked to lower academic achievement (Chiang, Maahs, Garvey, Hood, Laffel, Weinzimer, & Schatz, 2018).

The International Society for Paediatric and Adolescent Diabetes (ISPAD) recommends routine psychosocial screening for young individuals with T1DM to help prevent emotional and behavioral issues. Early detection through tools like the Strengths and Difficulties Questionnaire (SDQ), PHQ-2, GAD-7, and PAID-C/PAID-T can enable timely support. ISPAD advises that these assessments be performed regularly, especially during key developmental stages such as puberty, school transitions, or shortly after diagnosis—particularly when metabolic control is poor or treatment is not being followed.

Integrating mental health professionals into diabetes care teams offers a more comprehensive, patient-centered approach that addresses both physical and emotional needs. Effective support strategies may include individual or family therapy, peer support groups, and stress management programs, all of which can improve emotional resilience and enhance treatment outcomes (Lawrence, Albanese, Besancon, Black, Bratina, Chaney, & Mahmud, 2022).

RESEARCH METHOD

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review process commenced with the formulation of clinically relevant research questions. Prior to this, the authors applied the PICOS framework to define the scope and eligibility criteria for study selection. PICOS represents: P (population/problem), I (intervention or exposure), C (comparison or control group), O (outcome), and S (study design). For the purposes of this review, the components were defined as follows: Population (P): Children and adolescents diagnosed with T1DM; Intervention (I): Contributing or associated factors such as poor glycemic control, psychological stress, and duration of illness; Comparison (C): T1DM patients experiencing low versus high levels of fatigue; Outcome (O): Fatigue; Study Design (S): Observational studies.

The article search was conducted systematically using the keywords: “Child” AND “Children” AND “Adolescent” AND “Adolescence” AND “Teenagers” AND “Diabetes Mellitus Type 1” AND “Type” 1 Diabetes” AND “IDDM” AND “Type 1 Diabetes Mellitus” AND “Juvenile Onset Diabetes” AND “Psychosocial Problem” AND “Psychosocial Support System” AND “Psychological Support System” AND “Social Support System”.

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Inclusion criteria specified participants as children aged four years and older and adolescents aged between 9 and 18 years, with the majority falling within the 12–17 age range. Eligible participants were required to have a diagnosis of T1DM for a minimum duration of six months, possess basic literacy skills, and be free from severe disease complications or cognitive impairments. Additionally, informed consent was mandatory, either from the participants themselves or, in the case of minors, from their legal guardians.

Studies were excluded if participants were diagnosed with conditions other than T1DM—such as Type 2 Diabetes Mellitus—or were currently undergoing targeted psychological or fatigue-related interventions.

The initial database search yielded 32 articles from PubMed, 183 from ProQuest, 18 from Scopus, 104 from Wiley, and 145 from Taylor & Francis. Following a rigorous screening process based on the established inclusion and exclusion criteria, a total of six articles were deemed eligible for final analysis.

RESEARCH RESULTS

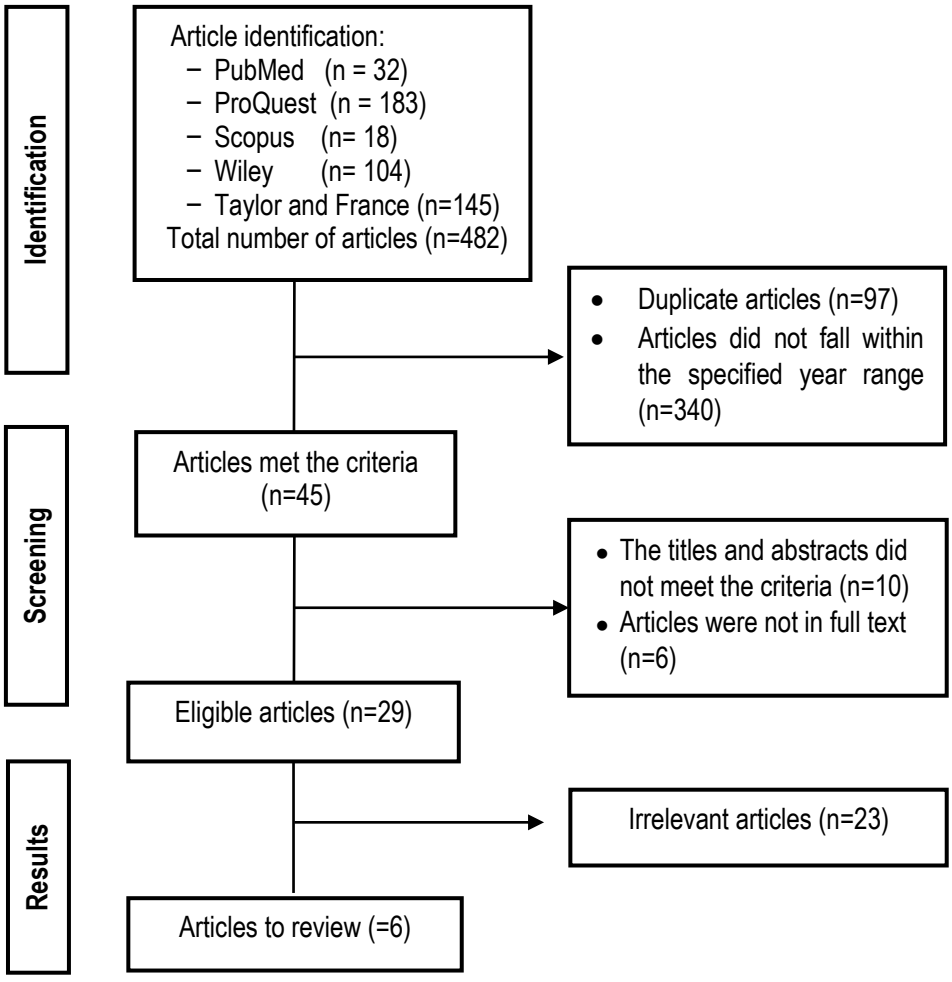


Figure 1. PRISMA Flow Diagram

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Table 1. Summary of the Included Studies

Author (Year) (Country)	Purpose	Method	Results
(Al Hayek et al., 2015) (Saudi Arabia)	To explore the fear of hypoglycemia (FOH) and anxiety-related emotional disorders and their risk factors among adolescents with type 1 diabetes mellitus (T1DM)	A cross-sectional study was conducted among 187 adolescents (aged 13-18 years; 92 males, 95 females) with T1DM at the Diabetes Treatment Center, Prince Sultan Military Medical City, Riyadh, Saudi Arabia, from June 2013 to February 2014. The participants were interviewed using FOH and Screen for Child Anxiety-Related Disorders (SCARED) scales	The strongest determinants of higher risk for the majority of the FOH and SCARED subscales were higher age, female gender, MDI treatment, longer duration of T1DM, higher frequency of hypoglycemia, passing out due to hypoglycemia, hypoglycemia while asleep and awake, and hypoglycemia in front of friends and at school.
(Wasserman et al., 2021) (Canada)	To categorize preadolescents based on clinical cut-offs of concurrently administered measures of depressive symptoms and diabetes distress and identify clinical and demographic characteristics of each group.	An observational study involving 180 youth (aged 9–13 years, M age= 11.3 ±1.3 years, 55% female, 56% Caucasian, M A1C= 8.4% (68 mmol/ mol) ±1.6%) completed measures of diabetes distress, depressive symptoms, and quality of life. Daily blood glucose monitoring frequency was calculated from meter download. A1C values were obtained from electronic medical records.	Depressive symptoms and diabetes distress each significantly correlated with A1C and quality of life. Although most (69%) participants had no clinically significant elevations in either diabetes distress or depressive symptoms, 14% had elevated depressive symptoms only and 17% had elevated distress without concurrent elevated depressive symptoms. Groups differed based on A1C, quality of life and insurance status.

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Author (Year) (Country)	Purpose	Method	Results
(Hadad et al., 2021) (Egypt)	To determine the prevalence of psychological and behavioral problems in children and adolescents diagnosed with type 1 diabetes and to find if there is a strong correlation between these problems and different epidemiological- and disease-related factors such as age of the child, duration of diabetes, and other risk factors	A cross-sectional study was applied by comparing between 564 children diagnosed with diabetes mellitus type 1 (who attended Specialized Health Insurance Clinic in Sohag City, Upper Egypt, during the year 2018/2020) and 564 non-diabetic children matched with the diabetic children for age, sex, and socio-economic status	Children with type 1 diabetes mellitus have more emotional, hyperactivity, conduct, and peer problems than non-diabetic children. These findings indicate a need to screen diabetic children and adolescents for behavioral and emotional problems and treat these problems if found.
(Koerner et al., 2023) (USA)	To examine anxiety and depressive symptoms in adolescents with type 1 diabetes (T1D) to determine differences based on grade level and disease duration.	A secondary data analysis of adolescents with T1D, which included demographic characteristics, general anxiety symptoms, and depressive symptoms.	Younger adolescents with T1D for > 6 months may be at a higher risk of a clinically significant symptom burden from depression and, therefore, should be screened at regular clinic visits. Adolescents diagnosed with T1D for at least 6 months, but < 3 years, may also be at a higher risk of experiencing anxiety and depressive symptoms than those living with T1D for several years. Future research should expand on these findings with larger.

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Author (Year) (Country)	Purpose	Method	Results
(Hamdan et al., 2024) (Jordan)	To fill the information gap by examining young Jordanian patients' knowledge and comprehension of type 1 diabetes mellitus (T1DM) and its treatment modalities, evaluating their psychological well-being, and examining the relationship between children's psychological health and self-care.	A cross-sectional study conducted in the Jordanian Ministry of Health hospitals in Amman from June 2021 to January 2022. A convenience sampling method was used to select Arabic-speaking diabetic patients aged 11-18 years who provided signed consent. A sample size of 400 was estimated. A self-administered questionnaire was developed based on a literature review to assess sociodemographic characteristics and diabetes and insulin knowledge, and validated scales were used to assess self-management (SMOD-A) and psychological well-being (ChilD-S).	Participants exhibited varying levels of knowledge about diabetes pharmacotherapy and self-management. Knowledge about diabetes was identified as a predictor for effective self-management. Moreover, glycemic control and diabetes mellitus awareness majorly impact overall self-management behaviors. Tailored education programs are necessary to fill knowledge gaps and enhance diabetes management among children.
(Neo et al., 2022) (Australia)	To investigate whether the COVID-19 pandemic affects the psychosocial impact of T1DM and glycaemic control.	During the 2020 lockdown, New South Wales residents were not allowed to leave home except for essential activities. After 3 months, children with T1DM and their parents were invited to complete online questionnaires. Data on glycaemic control were extracted from the children's clinical records with informed consent. Descriptive and comparative statistics were used to analyse the responses.	Despite life-style changes and a negative psychosocial impact, we did not find objective evidence of any detrimental impact of the lockdown on diabetic control. However, higher HbA1c correlated with children feeling more depressed and alone. There was a comparable frequency of anxiety concerning the risk of severe COVID illness in children and their parents.

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DISCUSSION

Analysis of six selected studies revealed that psychosocial outcomes—particularly anxiety—are prevalent among this population. Anxiety was found to be more prominent in older adolescents (aged 16–18), those undergoing multiple daily insulin injection (MDI) therapy compared to those using insulin pumps, and individuals diagnosed with T1DM between the ages of 3 and 7. These findings suggest that fatigue in T1DM youth is closely linked to psychosocial stressors, especially anxiety, which may be intensified by developmental challenges and the demands of diabetes management (Núñez-Baila, Gómez-Aragón, Marques-Silva, & González-López, 2024).

Adolescents aged 16 to 18 are particularly susceptible to increased psychological distress due to heightened autonomy, academic expectations, and social pressures. Patients on MDI therapy may perceive their treatment regimen as more intrusive, potentially lowering treatment satisfaction and contributing to emotional burden. Furthermore, those diagnosed at an early age (3–7 years) may face cumulative emotional strain due to long-term adaptation to the illness, ultimately leading to chronic fatigue during later developmental stages. These observations underscore the importance of individualized psychosocial interventions that address both the emotional and physical dimensions of fatigue in T1DM care (Kiriella, Islam, Oridota, Sohler, Dessenne, de Beaufort, & Aguayo, 2021).

Most participants in the reviewed studies had been diagnosed with T1DM for less than three years. Among high school students, those with T1DM were more likely to exhibit clinically significant depressive symptoms compared to their non-diabetic peers. Notably, the use of insulin pumps was associated with lower levels of anxiety and increased treatment satisfaction. Early adolescence appears to be a critical period marked by increased vulnerability to anxiety, reinforcing the need for routine psychological screenings. Additionally, a positive correlation was observed between elevated HbA1c levels and feelings of depression and loneliness, particularly during the COVID-19 pandemic. These findings highlight the intricate relationship between psychological well-being and diabetes management in pediatric populations. Recently diagnosed individuals, especially during academically demanding stages such as high school, may face heightened emotional distress, further complicating disease management. Thus, insulin pump therapy offers potential benefits beyond glycemic control by mitigating anxiety and enhancing overall psychosocial health (Montali, Zulato, Cornara, Ausili, & Luciani, 2022).

Routine psychological assessment is particularly crucial during early adolescence, a phase where individuals are prone to clinically significant anxiety. The association between poor glycemic control and increased emotional distress—especially during socially isolating periods such as the COVID-19 pandemic—emphasizes the need for integrated mental health services as a core component of diabetes care (Gomber, Ward, Ross, Owais, Mita, Yeh, & Atun, 2022).

Furthermore, fatigue was also identified as a contributing factor to psychosocial issues, notably depression. Depression was frequently reported in early adolescence (ages 9–15), especially among those diagnosed with T1DM for 6 months to under 3 years. One study in 2021 highlighted ethnicity as a contributing factor, noting that non-Hispanic individuals (87.1%) demonstrated a higher risk of depression. These data suggest that fatigue may not only result from but also contribute to depressive symptoms, particularly during the early adjustment phase post-diagnosis. Emotional fatigue from managing diabetes during formative years may increase susceptibility to depression (Bilgehan, & Uludasdemir, 2024).

Another psychosocial outcome associated with fatigue is the development of behavioral disorders. These disorders were found to be significantly associated with anxiety. Determinants contributing to such anxiety-related behavioral disturbances include a history of hypoglycemia, frequency of hypoglycemic episodes, impaired hypoglycemia awareness, age, gender, duration of diabetes, and time since the initiation of insulin therapy. Younger individuals and those newly introduced to insulin therapy may lack the psychological resilience and coping mechanisms needed to manage both the physiological and emotional challenges of diabetes, leading to a higher

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risk of behavioral dysregulation. These findings underscore the importance of routine psychosocial screening, taking into account both clinical history and behavioral indicators, to inform targeted intervention strategies (Mellerio, Guilmin, Jacquin, Labeguerie, Levy, & Alberty, 2015; Abdelseed, 2021).

Lastly, beyond anxiety, depression, and behavioral disorders, impaired self-management was also identified as a psychosocial challenge associated with fatigue. Fatigue can diminish a child's capacity to remain motivated, focused, and consistent in executing daily diabetes care tasks, including insulin administration, blood glucose monitoring, diet regulation, and physical activity. Prolonged fatigue reduces engagement in self-care behaviors, which may, in turn, impair glycemic control and elevate the risk of complications. For younger children, the ongoing burden of diabetes management may overwhelm their developing sense of autonomy, fostering emotional exhaustion and neglect of diabetes routines. These findings highlight the necessity of addressing fatigue as both a physical and psychosocial barrier to effective self-management. Comprehensive care should include psychosocial support, active family engagement, and tailored diabetes education to improve adherence and enhance quality of life in this vulnerable population (Segerer, Wurm, Grimsmann, Karges, Neu, Sindichakis, & Holl, 2021; Libman, Haynes, Lyons, Pradeep, Rwagasor, Tung, & Craig, 2022).

CONCLUSION

The findings of this review provide evidence-based support for the critical importance of early identification and comprehensive management of psychosocial difficulties associated with fatigue in children and adolescents with T1DM. By highlighting key contributing factors—including anxiety, depression, behavioral disturbances, and suboptimal self-management—this study emphasizes the necessity of implementing routine psychological assessments and adopting integrated, multidisciplinary care models. Early intervention targeting these psychosocial dimensions has the potential to alleviate their adverse effects, promote better treatment adherence, and ultimately enhance both glycemic control and overall quality of life among young individuals living with T1DM.

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